Glines Canyon Dam Removal

Text for inclusion in the Elwha River Restoration Project JARPA
All bold text is copied from the JARPA application. All responses are in normal text.

SECTION 2

4. NAME, ADDRESS, AND PHONE NUMBER OF PROPERTY OWNER(S), IF OTHER THAN APPLICANT.
National Park Service - Olympic National Park

5. LOCATION (STREET ADDRESS, INCLUDING CITY, COUNTY AND ZIP CODE, WHERE PROPOSED ACTIVITY EXISTS OR WILL OCCUR)
Elwha River, RM 13.4

LOCAL GOVERNMENT WITH JURISDICTION (CITY OR COUNTY)
Olympic National Park, Washington

WATERBODY
Elwha River

TRIBUTARY OF
N/A

WRIA#
18

¼ SECTION
SE ¼
SECTION
17
TOWNSHIP
29N
RANGE
7W

SHORELINE DESIGNATION
N/A

DNR STREAM TYPE, IF KNOWN
F

6. DESCRIBE THE CURRENT USE OF THE PROPERTY, AND THE STRUCTURES EXISTING ON THE PROPERTY. IF ANY PORTION OF THE PROPOSED ACTIVITY IS ALREADY COMPLETED ON THIS PROPERTY, INDICATE THE MONTH AND YEAR OF COMPLETION.
Glines Canyon Dam is currently owned by the National Park Service (NPS), and is operated and maintained by the Bureau of Reclamation (Reclamation). The dam is operated for hydropower generation under run-of-the-river conditions. Minimal flood control and recreational benefits are provided.

Glines Canyon Dam was originally constructed in 1926-1927, and impounds a reservoir (Lake Mills) having a surface area of 415 acres and a storage capacity of 40,500 acre-feet at elevation 590.33. Maximum power generation of 13.3 MW occurs with 1,150 ft^3/s released through the single turbine.

Glines Canyon Dam

Arch dam C The varied radius, concrete, thin-arch dam has a structural height of 210 feet, with a crest length of 150 feet at elevation of 590.33 feet, a crest width of 4 feet, a base width of 46 feet, and an estimated volume of 15,200 yd^3 above elevation 400.0. The upper 50 feet of the arch dam is reinforced near the abutments. The downstream face is vertical above elevation 426 and the upstream face is curved. An abandoned low-level outlet works, or sluiceway, is located through the arch dam at centerline elevation 450.33. The outlet consists of a circular intake with a hinged, hemispherical trashrack, a 6-foot-long transition from an 11-foot-diameter to a 5-foot-diameter conduit, a 60-inch-diameter butterfly valve, and an 18-foot-long outlet transition from a 5-foot-diameter to a 6.5-foot- diameter conduit. A vertical ladder well on the downstream face of the arch dam and a horizontal adit provides access from the dam crest to the butterfly valve operator, which reportedly has not been operated since original construction.

A concrete walkway and supporting piers were removed from the dam crest in 1969 to facilitate dam overtopping for passage of large floods up to the PMF. The dam crest serves as an overflow spillway with a discharge capacity of 86,000 ft^3/s at maximum water surface elevation 611.8. A concrete apron extends about 36 feet downstream from the dam between the canyon walls for erosion protection at the toe of the dam.

The downstream face of the arch dam was closely examined by Harza Northwest, Inc. in September 1991, and was found to be in very good condition, with no cracking, spalling, or significant seepage observed. Non-destructive strength testing of the downstream face resulted in relative concrete strengths ranging from 2,800 to 3,200 lbs/in^2. The upper 18 feet of the upstream face of the arch dam was observed during the reservoir draw-down test in April 1994 and there were no visible signs of structural distress. An underwater inspection of the arch dam was performed in 1994 by Reclamation=s Pacific Northwest Regional Office using a remote-controlled camera, with no problems reported. Vertical and horizontal movements at measurement points on the arch dam, thrust block, gravity section, and penstock anchor have been satisfactory since monitoring began in 1966.

Thrust block and gravity section C The right end of the arch dam contacts a concrete gravity thrust block, adjoining a low concrete gravity section and a reinforced concrete wall on the right abutment. The thrust block is 20 feet wide and 30 feet long at crest elevation 600.33, and extends up to 40 feet above the bedrock foundation. The thrust block includes an abandoned 6 feet wide log flume along the far face, with an invert at elevation 581.3. The gravity section is 55 feet long and contains a 0.7:1 downstream face batter below an elevation 593, with an 18-inch-thick wall above this elevation. The reinforced concrete wall is 55 feet long and 3 feet thick. The gravity section and concrete wall contain a 6-foot-wide, 12-inch-thick reinforced concrete deck at elevation 600.33. The thrust block, gravity section, and concrete wall have a total estimated volume of 2,100 yd^3. Post-tensioned, grouted and ungrouted tendons were installed in the gravity section in 1969, 1973, and 1989 to improve structural stability during overtopping and seismic events. Lampposts and handrails are located along the perimeter of the thrust block and reinforced concrete deck.

Embankment dikes C An earthfill embankment is located beyond the concrete wall and gravity section on the upper right abutment, and was modified in 1969 for containment of the probable maximum flood (PMF). The embankment has a crest length of 175 feet at elevation 612.33, a crest width of 8 feet, and 1:1 slopes. Riprap slope protection is provided on the upstream slope below elevation 595, with grass cover above elevation 595 and on the downstream slope. The embankment contains a concrete core wall and has a maximum height of 80 feet above the bedrock foundation. The total estimated volume of the embankment is 5,500 yd^3. A second earthfill embankment was constructed on the upper left abutment beyond the gated spillway in 1973 for containment of the PMF. The embankment has a crest length of 260 feet at elevation 612.33, a crest width of 8 feet, and 1-1/2:1 slopes protected by grass cover. The total estimated volume of the embankment is 2,400 yd^3.

Glines Canyon Dam

Gated spillway C A gated spillway is located on the left abutment of the dam, with an overflow crest at elevation 570.33, and five 20- by 20-foot Tainter gates with a maximum release capacity of 63,000 ft^3/s at reservoir elevation 611.8. Spillway releases pass through a reinforced concrete chute and flip structure to the river channel below. The spillway structure has a total length of 120 feet a t the bridge deck (elevation 600.3) and an estimated concrete volume of 2,500 yd^3. Post-tensioned, fully grouted tendons were installed in the spillway piers in 1989 to improve structural stability during overtopping and seismic events. Each steel Tainter gate has a radius of 15 feet from the trunnion pin at elevation 578.33. A single hoist motor is located on the hoist deck for gate operation.

Intake structure C A 115-foot-high intake structure is located at the upstream end of the power penstock tunnel, about 200 feet from the left abutment shoreline. The lower intake chamber (at the tunnel portal) and the upper trashrack tower are reinforced concrete, with a combined volume of 450 yd^3.

Power penstock tunnel C The power penstock tunnel extends 568 feet between portals through the left abutment of the dam. The upstream portion is lined with concrete on the crown and sidewalls only, with a minimum diameter of 11 feet and a length of 167 feet. A 45-foot-long, concrete-lined transition is provided for the rectangular guard gate section at station 1+92, with a sill at elevation 503.33. The downstream portion of the power penstock tunnel is concrete-lined for about 172 feet (11-foot diameter), dropping about 27 feet in elevation, and then is unlined for the final 184 feet (13.5-foot diameter). The unlined portion contains a 10-foot-diameter riveted steel pressure pipe.

Gatehouse and shaft C A reinforced-concrete gatehouse (floor elevation 606.75) is supported on concrete columns 17.5 feet above an 86-foot-deep, concrete-lined gate shaft extending to the power penstock tunnel invert. A 7- by 12-foot caterpillar guard gate is located within the 3- by 9-foot gate shaft for emergency closure and for penstock maintenance. Access to the power penstock tunnel is located downstream of the guard gate slot by a 2.5- by 2.5-foot access shaft. The gate and access shafts are covered by steel grating at the lower deck elevation 589.2. Access to the gatehouse is provided by a concrete footbridge. The gatehouse, support columns, and footbridge have a combined estimated concrete volume of 30 yd^3. The portion of the gate shaft above the ground surface has an estimated concrete volume of 60 yd^3.

Penstock and surge tank C A 10-foot-diameter steel penstock extends about 75 feet from the downstream tunnel portal at station 5+70 to a steel transition and surge tank. The surge tank is about 150 feet high and is located at station 6+70 (centerline). The steel tank is 20 feet in diameter, with an 11-foot-diameter riser pipe and steel support structure on concrete footings. The penstock transitions to an 11.58-foot-diameter and drops about 73 feet between station 6+90 (downstream from the surge tank) and station 7+96 (at the powerhouse). A stairway is located on the sloping penstock for access to the surge tank, downstream tunnel portal, and transformer yard.

Powerhouse C The powerhouse is located 700 feet downstream from the dam on the left abutment, and includes a vertical Francis-type turbine generator (centerline station 8+26, elevation 403.33) rated at 13,333 kVA and 17,500 horsepower for commercial use, a horizontal Pelton-type turbine generator rated at 50 kW for station service, and governors and other auxiliaries for the units. Penstock releases are controlled by wicket gates at the vertical turbine generator, with an 8.5-foot-diameter, hydraulically-operated butterfly valve provided just upstream. The unit has a maximum release capacity of 1,150 ft^3/s while generating power.

The powerhouse is reinforced concrete and measures approximately 40 by 60 feet, covering an area of about 2,400 ft^2. The superstructure (above the main floor, elevation 410.33) has an estimated concrete volume of 500 yd^3. A concrete retaining wall located at the powerhouse within the tailrace area has a top width of 3 feet and is approximately 55 feet long, for an

estimated volume of 140 yd^3. A small metal shed near the powerhouse measures 12 by 20 feet and covers an area of 240 ft^2. Access to the powerhouse is provided by an unpaved road from the left (west) abutment access road (Olympic Hot Springs Road).

Transformer yard C A transformer yard, or substation, located on the left abutment above the powerhouse, is where the generator voltage is transformed to 69 kV and conveyed about 7 miles via an overhead three-phase transmission line (Line No. 3) to Elwha Dam. The yard contains electrical transformer equipment within a fenced area, including three single-phase transformers, a circuit breaker, and a disconnect switch. A metal shop building located near the transformer yard measures 20 by 20 feet, covering an area of 400 ft^2. Access to the transformer yard is by unpaved road from the left abutment access road, or by stairway and footpath from the powerhouse.

Log boom C An extensive log boom system is located on the reservoir about 300 feet upstream from the dam, consisting of logs cabled or chained together and anchored on both abutments. Provisions have been made for boat passage, and for periodic release of accumulated debris through the log boom and over the dam crest.

Maintenance shop and outbuildings C Two wood-frame residences, a boat house, and a maintenance shop are located on the left abutment of the dam. The two-story residences each measure 25 by 35 feet in plan view, covering a combined area of 1,750 ft^2. The maintenance shop measures 27 by 50 feet, covering an area of 1,350 ft^2. The maintenance shop is one of the original construction camp buildings, and has the original blacksmith shop intact.

IS THIS PROPERTY ON AGRICULTURAL LAND?
No

ARE YOU A USDA PROGRAM PARTICIPANT?
No

7.a. DESCRIBE THE PROPOSED CONSTRUCTION AND/OR FILL WORK FOR THE PROJECT THAT YOU WANT TO BUILD THAT NEEDS AQUATIC PERMITS: COMPLETE PLANS AND SPECIFICATIONS SHOULD BE PROVIDED FOR ALL WORK WATERWARD OF THE ORDINARY HIGH WATER MARK OR LINE, INCLUDING TYPES OF EQUIPMENT TO BE USED. IF APPLYING FOR A SHORELINE PERMIT, DESCRIBE ALL WORK WITHIN AND BEYOND 200 FEET OF THE ORDINARY HIGH WATER MARK. ATTACH A SEPARATE SHEET IF ADDITIONAL SPACE IS NEEDED.

Dam removal activities at Glines Canyon Dam are expected to require three years to complete. The powerplant would first be decommissioned by removal of the turbine runner from the vertical unit, and by the removal or remediation of hazardous materials. This would permit an initial drawdown of Lake Mills in approximate 10-foot stages every two weeks, using the existing spillway gates and the low-level penstock outlet, to a maximum depth of about 50 feet (depending upon reservoir inflow and discharge capacity). This initial drawdown would allow the early erosion and redistribution of the coarser delta sediments closer to the dam prior to commencement of dam removal activities, and is planned for June through October, 2008. No significant sediment release would be expected during this initial drawdown. The reservoir would refill during winter and spring flows.

Dam removal activities would begin after November 15, 2008 with contractor mobilization and necessary improvements to the Olympic Hot Springs Road for equipment access to the left abutment of the dam. The left abutment dike would be removed by front-end loader and dump truck, to construct a crane pad and a staging area above elevation 600. The concrete apron at the toe of the arch dam would be broken in place using a hoe-ram, and the downstream channel would be cleared of large boulders and debris using explosives and a front-end loader. Alternatively, a crane and skip could be used to remove the waste materials and debris from the

river channel near the dam. The existing spillway gates and the low-level penstock outlet would be used to draw the reservoir down at a controlled rate to maintain the stability of the upstream reservoir slopes and meet downstream ramping rate restrictions.

The concrete arch dam section would be removed in minimum 7.5-foot lifts, using diamond-wire sawcutting in reinforced areas and at the contacts with the adjoining thrust block and spillway structures (to remain), and in conjunction with presplit blasting methods elsewhere to excavate the concrete in large blocks up to 35 tons each (or up to 18 yd^3) . Presplit blasting would be primarily used to provide the longitudinal cuts and to complete a diversion notch at each lift for reservoir releases below the minimum operating level of the penstock outlet. An estimated two concrete blocks would be removed from the dam each day using a large ringer crane (with 300-foot boom) on the left abutment, to be hauled away on flat-bed trucks for off-site disposal (either in blocks or crushed for recycling). Alternating diversion notches about 25 feet wide and 15 feet deep would be capable of handling average annual streamflows with sufficient drawdown to expose each new lift for excavation in the dry. A hoe-ram may be required to remove any concrete remaining on the dam abutments following block removal.

The reservoir would be drawn down in minimum 7.5-foot increments about every two weeks, except that no draw down would be permitted between May 1 and June 30, August 1 and September 14, and from November 1 to December 31, from 2009 to 2011, to preserve downstream water quality for fish by minimizing sediment releases. The lower portion of the arch dam section, including the existing sluiceway, would be removed by blasting in minimum 7.5-foot lifts to the final streambed elevation of 400 feet. All excavation operations would attempt to confine the concrete rubble to the dam crest to the maximum extent possible, for removal using the ringer crane and skip. Any remaining concrete rubble would be removed from the river channel during low flow in October 2011, using a front-end loader and dump trucks. The concrete training wall at the powerhouse would also be removed from the river channel during this period using a hoe-ram and front-end loader.

The penstock intake tower and the surge tank would be demolished by blasting, and removed for off-site disposal using front-end loaders and dump trucks. The tunnel portals would be sealed with concrete and the penstock at the surge tank location would be sealed with a steel plate. The concrete thrust block, gravity wall, and dike embankment on the right abutment, and the left abutment spillway gate structure, would be retained for use as public overlooks, with appropriate safety features provided. The penstock, gate house, powerhouse, and other buildings at the site may be retained for either their historical significance or interpretive potential within the Olympic National Park. Final site cleanup would include the removal of the transformer yard equipment, metal shed, fencing, and shaping and seeding of the construction areas.

7.b. DESCRIBE THE PURPOSE OF THE PROPOSED WORK AND WHY YOU WANT OR NEED TO PERFORM IT AT THE SITE. PLEASE EXPLAIN ANY SPECIFIC NEEDS THAT HAVE INFLUENCED THE DESIGN.

The Elwha River Ecosystem and Fisheries Restoration Act (Public Law 102-495), passed by Congress in 1992, requires the "…full restoration of the Elwha River ecosystem and native anadromous fisheries." The removal of Elwha and Glines Canyon Dams was determined by the Secretary of the Interior to be the only alternative that would achieve the goal desired by Congress. The plan to meet this goal includes the following objectives:

- Safely remove Elwha and Glines Canyon Dams.
- Accommodate river flows during dam removal, through diversion channels and excavated notches.
- Facilitate sediment management through controlled releases and systematic construction schedules.
- Address environmental issues by planning work shutdowns during certain periods.
- Retain certain structures for historical preservation at Glines Canyon Dam, allowing

public viewing of the site from structures on both abutments and retaining the historic powerhouse.
- Achieve reasonable costs by limiting structure removal at Glines Canyon Dam and by selecting construction methods that are economical but do not sacrifice safety.

7.c. DESCRIBE THE POTENTIAL IMPACTS TO THE CHARACTERISTIC USES OF THE WATER BODY. THESE USES MAY INCLUDE FISH OR AQUATIC LIFE, WATER QUALITY, WATER SUPPLY, RECREATION AND AESTHETICS. IDENTIFY PROPOSED ACTIONS TO AVOID, MINIMIZE, OR MITIGATE DETRIMENTAL IMPACTS, AND PROVIDE PROPER PROTECTION OF FISH AND AQUATIC LIFE. ATTACH A SEPARATE SHEET IF ADDITIONAL SPACE IS NEEDED.

Short-term Impacts due to Construction Include:
- Temporary increase in suspended sediments and turbidity affecting fish and aquatic life and water quality.
- Localized modification of river hydrology affecting fish and aquatic life.

Long-term Impacts Include:
- Alteration of the character of the streambed and the river hydrology affecting fish and aquatic life.
- Draining approximately 47.43 acres of lake-fringe and riverine wetlands.
- Increase in fish populations in the watershed by improving fish passage characteristics of this section of the Elwha River.

Mitigation Measures during Construction Include:
- Minimizing the impacts to existing, healthy vegetation to the extent possible.
- Use of proactive and reactive BMP's at the site.
- Use of cofferdams to isolate the construction area from the river.
- Work in the river during low flow.

Mitigation Measured for Long-Term Impacts Include:
- Removal of the dam to permit restoration of a naturally free flowing river.
- Revegetation of the existing reservoir area with indigenous native flora.

8. WILL THE PROJECT BE CONSTRUCTED IN STAGES?
Yes, the Elwha and Glines Dam Removal occur after and separately from other elements of the project.

PROPOSED STARTING DATE:
Dam removal will occur beginning in 2009. The exact starting date will be determined based on completion of water quality mitigation elements.

ESTIMATED DURATION OF ACTIVITY:
Overall dam removal will require approximately 48 months.

9. CHECK IF ANY STRUCTURES WILL BE PLACED:

WATERWARD OF THE ORDINARY HIGH WATER MARK OR LINE FOR FRESH OR TIDAL WATERS.
No

WATERWARD OF MEAN HIGH WATER LINE IN TIDAL WATERS:

No.

10. WILL FILL MATERIAL (ROCK, FILL, BULKHEAD, OR OTHER MATERIAL) BE PLACED:

WATERWARD OF THE ORDINARY HIGH WATER MARK OR LINE FOR FRESH OR TIDAL WATERS.
Yes. Incidental fill may occur during the dam removal process.

WATERWARD OF MEAN HIGH WATER LINE IN TIDAL WATERS.
No.

11. WILL MATERIAL BE PLACED IN WETLANDS?
No.

G. WILL PROPOSED ACTIVITY CAUSE FLOODING OR DRAINING OF WETLANDS?
Drawdown of the Lake Miles will cause the draining of 43.47 acres of lake-fringe and riverine wetlands associated with the OHWM of the reservoir upstream of the dam.

Wetland	Acres
33	29.9
34	5.6
35	1.5
36	2.5
64	.34

13. WILL EXCAVATION OR DREDGING BE REQUIRED IN WATER OR WETLANDS?
Incidental fill from dam removal will be excavated from the river channel during the final clean up process.

A. VOLUME: The quantity of incidental fill is undetermined.

B. AREA: The area is likely to be less than 0.10 acre

C. COMPOSITION OF MATERIAL TO BE REMOVED:
Concrete rubble.

D. DISPOSAL SITE FOR EXCAVATED MATERIAL:
All materials produced from the removal of the dam will be disposed at approved and regulated sites.

E. METHOD OF DREDGING
Hydraulic excavation or similar conventional earthmoving equipment.